

MI987

Intel® Q87 / H81 Based Mini-ITX board
Mini ITX Motherboard

USER'S MANUAL

Version 1.0

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Introduction

Product Description

The MI987 Mini ITX motherboard is based on the latest Intel® Q87 chipset. The platform supports Intel® 4th Generation CoreTM DT i7/i5/i3 processors.

The latest Intel® processors provide advanced performance in both computing and graphics quality. This meets the requirement of customers in the gaming, POS, digital signage and server market segment.

The platform supports two SO-DIMM sockets that can accommodate up to 16GB of DDR3-1600 Non ECC memory. The Intel® 4th Gen. Core™ DT processor integrated HD graphics supports 3 independent displays, Direct X 11.1, OpenGL 3.2, and Open CL 1.2. Display interfaces are for HDMI, DisplayPort and VGA CRT.

With two Gigabit Ethernets, the MI987 Mini ITX board utilizes the dramatic increase in performance provided Intel's latest cutting-edge technology. Expansion is provided by PCIe(4x), two full sized MiniPCIe and a half sized MiniPCIe. Onboard connectors support 2x SATAIII, 4x or 6x USB 2.0 depending on the MI987 model and 2x COM ports. The board measures 170mm x 170mm.

Checklist

Your MI987 package should include the items listed below.

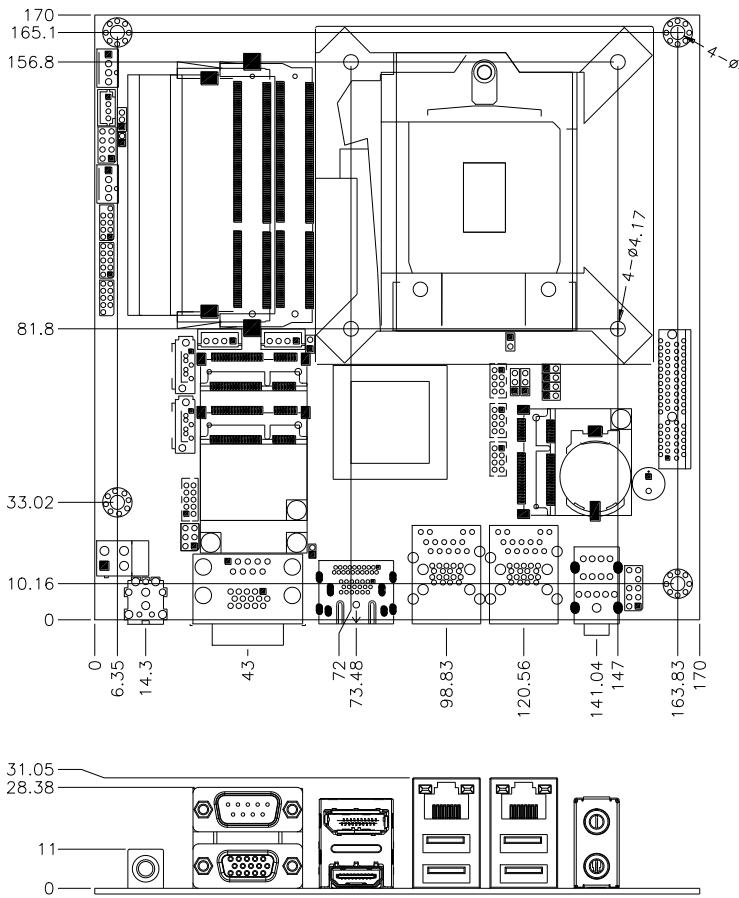
- The MI987 MINI ITX motherboard
- This User's Manual
- 1 CD containing chipset drivers and flash memory utility
- Cables??????????????????

MI987 Specifications

Product Name	MI987AF (Q87) MI987EF (H81) MI987AF-W (Q87) [Optional for iBASE SG]
Form Factor	Mini ITX
CPU Type	- Intel® 4 th Generation Core™ DT i7/i5/i3 processors (22nm monolithic) **Recommend to use low power DT CPU @ TDP 35W/45W**
CPU Speed	Up to 2.7GHz
Cache Size	Up to 8MB
CPU Socket	LGA1150 (Socket H3)
Chipset	Intel® Q87 PCH [MI987AF/MI987AF-W] Intel® H81 PCH [MI987EF] Package =23 mm x 22 mm, 0.65 mm ball pitch
BIOS	AMI BIOS
Memory	Intel® 4 th Gen Core™ DT processors integrated memory controller, - DDR3-1600 MHz@1.5V - SO-DIMM x 2, Max. 16GB (Non-ECC) [Horizontal type]
VGA	Intel® 4 th Gen. Core™ DT processor integrated HD Gfx, supports 3 independent displays, Direct X 11.1, OpenGL 3.2, Open CL 1.2 - HDMI x 1 (Thru port B, with Level shifter PTN3360D) - DisplayPort x 1 (Thru port C) **support DP++** - VGA x 1 (Thru PCH)
LAN	1. Intel® I217LM PHY [MI987AF/-W] or I217V GbE PHY [MI987EF] 2. Intel® I211AT PCIe GbE as 2 nd LAN
USB	USB 2.0 host controller [Q87/H81 Integrated] - [MI987AF/-W] : 6 ports via onboard pin header - [MI987EF] : 4 ports thru pin header, 2 ports @edge I/O connectors - 2 ports via MiniPCIe socket USB 3.0 host controller [Q87 /H81 Integrated] @ edge I/O connectors - USB 3.0 x 4 ports for MI987AF/-W - USB 3.0 x 2 ports for MI987EF
Serial ATA	Intel® Q87/ H81 PCH built-in SATA controller, - 2x SATA 3.0 (6Gbps) - 2 x mSATA [Q87 PCH Port 3/4 for SATA (3.0) or H81 PCH Port 3/4 for SATA(2.0)]
Storage Device	mSATA x 2 thru full-sized/half-sized Mini-PCIe socket @J12/J13 socket
Audio	Intel® Q87/H81 PCH built-in High Definition Audio controller + Realtek ALC662 w/ 5.1 channels
LPC I/O	Nuvoton NCT5523D (64-pin LQFP [7 mmx7 mm]) - COM #1 (RS232/422/485) support ring-in with power @500 mA (selectable for 5V or 12V) [EXAR SP339EER1 232/422/485 transceiver x 1 for jumper-less] - COM #2 (RS232 only) Hardware Monitor (2 thermal inputs, 4 voltage monitor inputs & 2 Fan headers) - CPU FAN x 2 (PWM/DC type, 4-pin connector type, auto-detection by Nuvoton NCT3943S fan controller)
Digital IO	4 in & 4 out
IAMT 9.0	MI987AF/-W only
TPM 1.2	Infineon SLB9655 [MI987AF/-W only]

Expansion Slots	- PCIe (4x) x1 [Gen 3.0 PEG] [MI987AF/EF] - MiniPCIe socket x 2 [Full-sized + Half-sized stack type, Full-sized support PCIe/USB/ mSATA , Half-sized support mSATA only] - Half-sized socket x 1 (3 rd Mini-PCIe@J16, support PCIe / USB)
Edge Connectors	DC-Jack x 1(C12135112DC102000P) DB9+DB15 stack connector for COM #1 + CRT DP + HDMI stack connector x 1 Dual USB (3.0) + RJ45 stack connector x 2 ** For MI987EF, USB 3.0 @ CN7 is USB2 only** Audio Jack 2 x 1 for MIC-in / Line-out (Reserved for 2-port connector)
Onboard Header/Connector	2 ports x SATA III [Blue color] DF-11 2x4 pins pin-header x 3 for 6 ports USB 2.0 (MI987AF/-W) DF-11 2x4 pins pin-header x 2 for 4 ports USB 2.0 (MI987EF) DF-11 2x6 pins pin-header x 1 for front panel audio DF-11 2x5 pins box header x 1 for COM2 (RS232) 2x5 pins pin-header x1 for Digital IO 4 pins mini-type header for SATA device power x 2 [JST type] 2 x 4 pins pin header x 1 for front I/O (2.54 pitch)
Watchdog Timer	Yes (256 segments, 0, 1, 2...255 sec/min)
System Voltage	<u>+19V</u> DC-in ($\pm 20\%$)
Other	- LAN Wakeup - EuP/ErP (MI987EF only, thru Super I/O) - iSMART function(TI MSP430G2433 MCU) - Legacy Free from super I/O - AT24C02C EEPROM [SO8 type] via SMBus
Board Size	170mm x 170mm
Operation System	Windows 7, Windows 8

Board Dimensions



Installations

This section provides information on how to use the jumpers and connectors on the MI987 in order to set up a workable system. The topics covered are:

Installing the Memory	錯誤! 尚未定義書籤。
Setting the Jumpers	錯誤! 尚未定義書籤。

Connectors on MI987 錯誤! 尚未定義書籤。

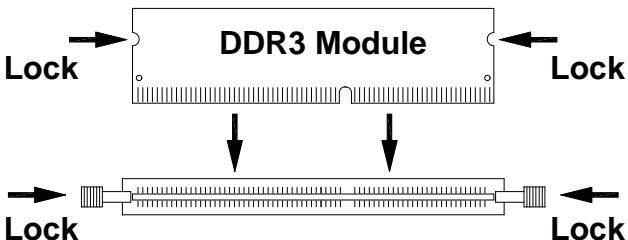
Installing the Memory

The MI987 board supports two DDR3 memory modules for a maximum total of 16GB in DDR3 SODIMM memory type.

Installing and Removing Memory Modules

To install the DDR3 modules, locate the memory slot on the board and perform the following steps:

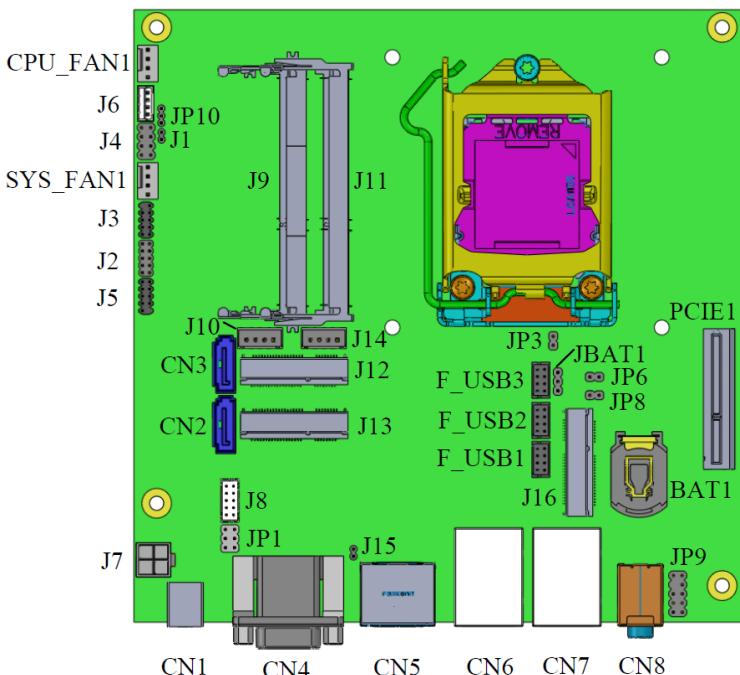
1. Hold the DDR3 module so that the key of the DDR3 module aligned with that on the memory slot.
2. Gently push the DDR3 module in an upright position until the clips of the slot close to hold the DDR3 module in place when the DDR3 module touches the bottom of the slot.
3. To remove the DDR3 module, press the clips with both hands.



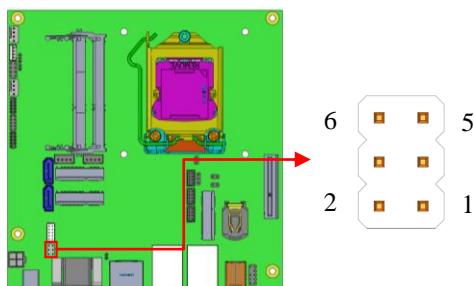
Setting the Jumpers

Jumpers are used on MI987 to select various settings and features according to your needs and applications. Contact your supplier if you have doubts about the best configuration for your needs. The following lists the connectors on MI987 and their respective functions.

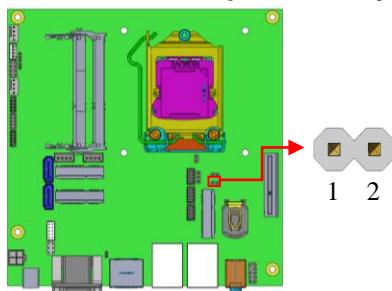
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Jumper Locations on MI987

Jumpers on MI987 Page

JP1: COM1 RS232 RI/+5V/+12V Power Setting

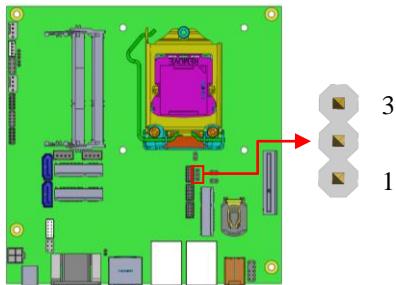
JP1	Setting	Function
	Pin 1-3 Short/Closed	+12V
	Pin 3-4 Short/Closed	RI
	Pin 3-5 Short/Closed	+5V

JP8: Flash Descriptor Security Override (Factory use only)

JP8	Flash Descriptor Security Override
Open	Disabled (Default)
Close	Enabled

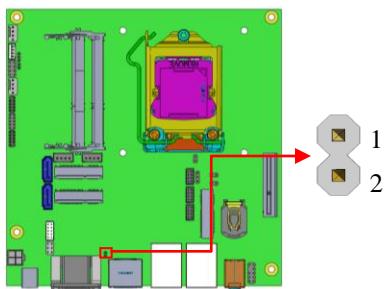
INSTALLATIONS

JBAT1: Clear CMOS Contents

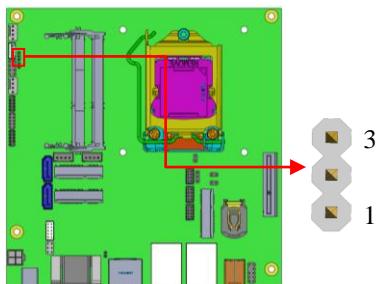


JBAT1	Setting	Function
	Pin 1-2 Short/Closed	Normal
	Pin 2-3 Short/Closed	Clear CMOS

J15: DP++ Select



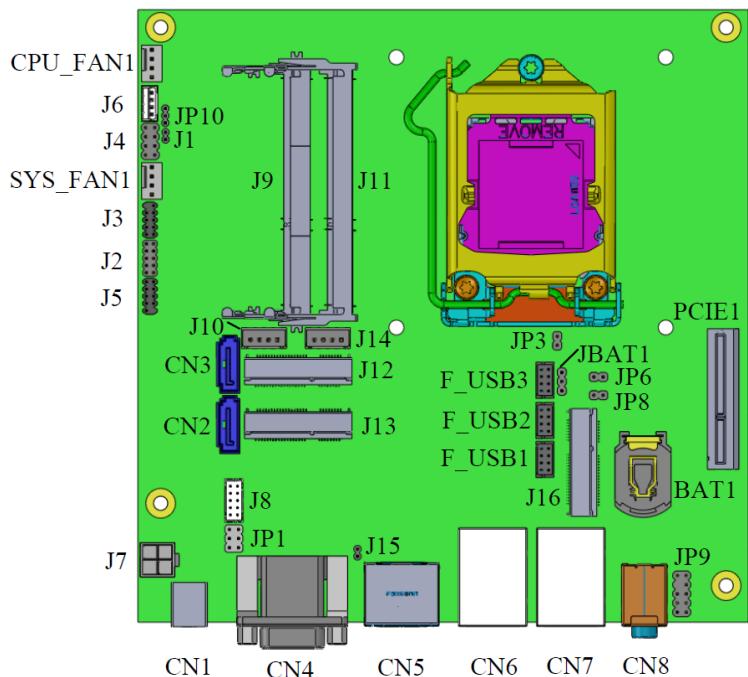
JP15	Function
Short	Display Port
Open	Dongle /DP to DVI / DP to HDMI

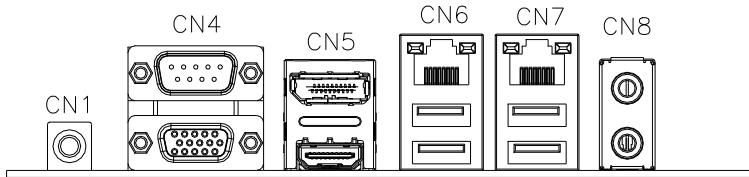
JP10: Power On Type

JP10	Function
1-2	ATX Mode (Default)
2-3	AT Mode

Connectors on MI987

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Connector Locations on MI987



CN4: CRT/COM1 Connector

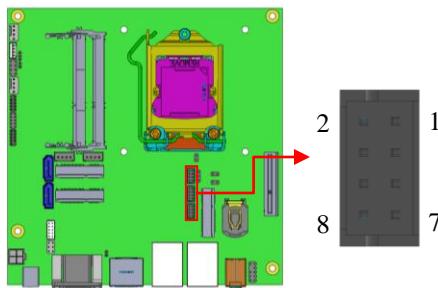
CN5: DP/HDMI Connector

CN6: Gigabit LAN (Intel I217LM) / USB3.0

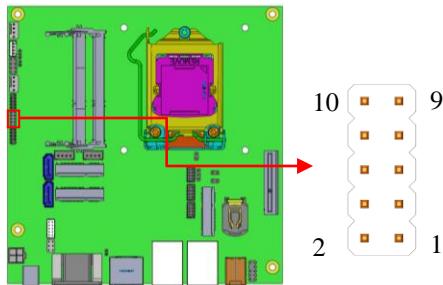
CN7: Gigabit LAN (Intel I211AT) / USB3.0(EF Ver with USB2.0)

CN2, CN3: SATA3 Connectors

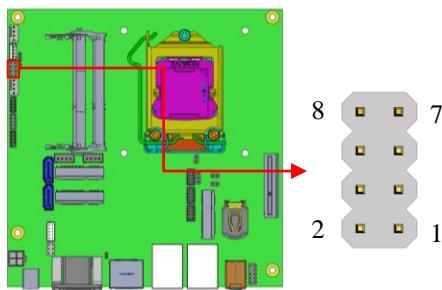
F_USB1/2/3: USB Connectors



Signal Name	Pin	Pin	Signal Name
VCC	1	2	GND
D0-	3	4	D1+
D0+	5	6	D1-
GND	7	8	VCC

J2: Digital I/O

Signal Name	Pin	Pin	Signal Name
GND	1	2	VCC
OUT3	3	4	OUT1
OUT2	5	6	OUT0
IN3	7	8	IN1
IN2	9	10	IN0

J4: Front Panel Function Connector**ATX Power ON Switch: Pins 1 and 2**

This 2-pin connector is an “ATX Power Supply On/Off Switch” on the system that connects to the power switch on the case. When pressed, the power switch will force the system to power on. When pressed again, it will force the system to power off.

Hard Disk Drive LED Connector: Pins 3 and 4

This connector connects to the hard drive activity LED on control panel. This LED will flash when the HDD is being accessed.

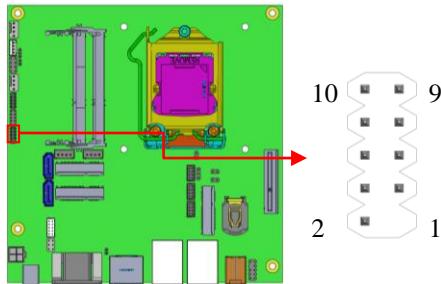
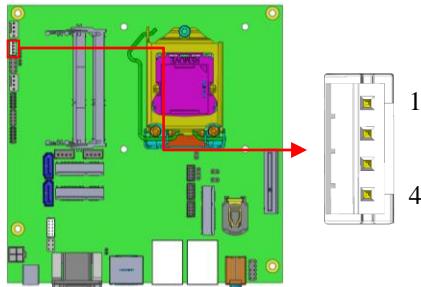
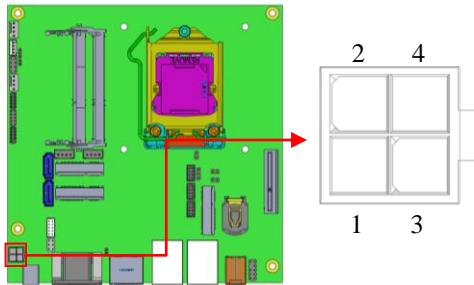
Pin #	Signal Name
4	HDD Active
3	3.3V

Reset Switch: Pins 5 and 6

The reset switch allows the user to reset the system without turning the main power switch off and then on again. Orientation is not required when making a connection to this header.

Power LED: Pins 7 and 8

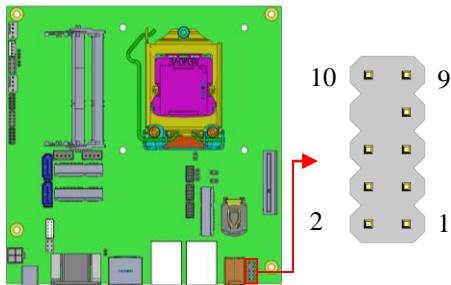
Pin #	Signal Name
7	+5V
8	GND

J5: SPI Flash Connector (Factory use only)**J6: MCU Flash Connector (factory use only)****J7: DC-in Jack (19V)**

Pin #	Signal Name
1	Ground
2	Ground
3	DC_IN
4	DC_IN

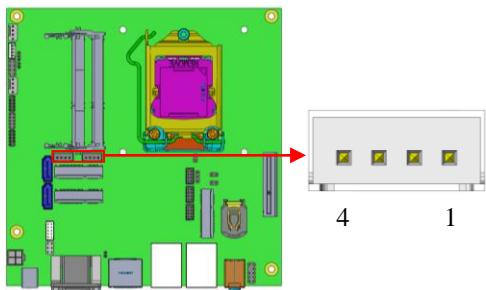
INSTALLATIONS

JP9: Audio Front Header

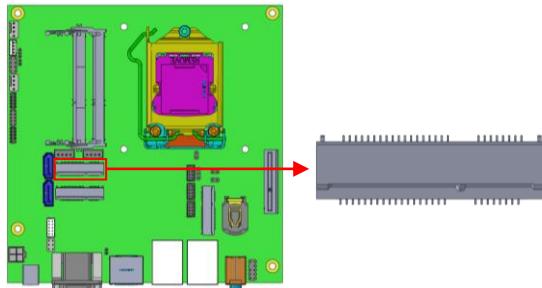
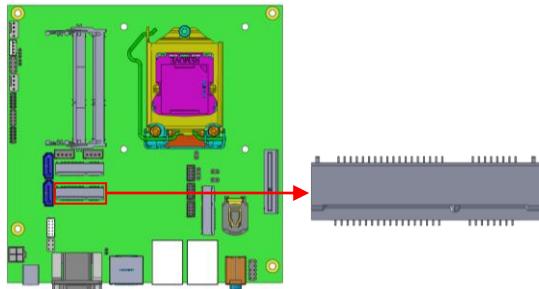
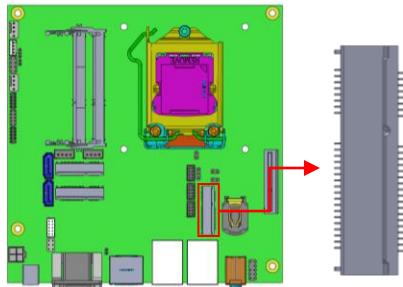
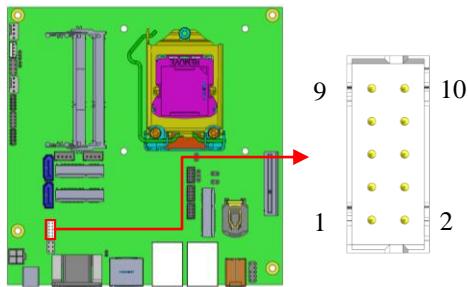


Signal Name	Pin #	Pin #	Signal Name
MIC2_L	1	2	Ground
MIC2_R	3	4	Presence#
Line2_R	5	6	MIC2_ID
Sense	7	8	NC
Line2_L	9	10	Line2_ID

J10/J14: HDD Power Connector (Output Only)



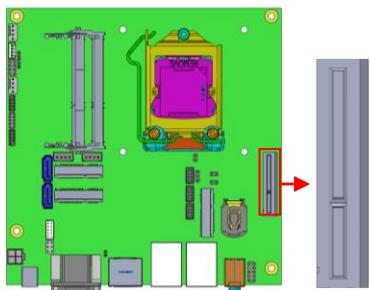
Pin #	Signal Name
1	+5V
2	Ground
3	Ground
4	+12V

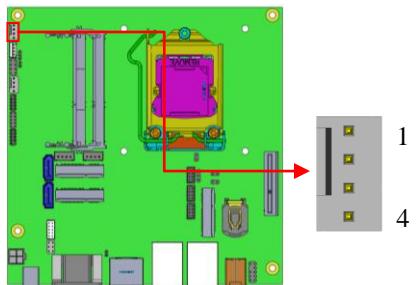
J12: Mini PCIE/mSATA Connector**J13: mSATA Connector****J16: Mini PCIE Connector****J8: COM2 Connector**

INSTALLATIONS

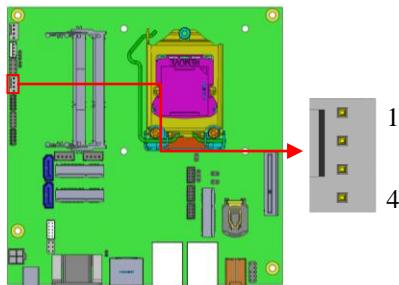
Signal Name	Pin #	Pin #	Signal Name
DCD, Data carrier detect	1	2	RXD, Receive data
TXD, Transmit data	3	4	DTR, Data terminal ready
GND, ground	5	6	DSR, Data set ready
RTS, Request to send	7	8	CTS, Clear to send
RI, Ring indicator	9	10	Not Used

PCIE1: PCIE_x4 Slot



CPU_FAN1: CPU Fan Power Connector

Pin #	Signal Name
1	Ground
2	+12V
3	Rotation detection
4	Control

SYS_FAN1: System Fan1 Power Connector

Pin #	Signal Name
1	Ground
2	+12V
3	Rotation detection
4	Control

INSTALLATIONS

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BIOS Setup

This chapter describes the different settings available in the AMI BIOS that comes with the board. The topics covered in this chapter are as follows:

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BIOS Introduction

The BIOS (Basic Input/Output System) installed in your computer system's ROM supports Intel processors. The BIOS provides critical low-level support for a standard device such as disk drives, serial ports and parallel ports. It also password protection as well as special support for detailed fine-tuning of the chipset controlling the entire system.

BIOS Setup

The BIOS provides a Setup utility program for specifying the system configurations and settings. The BIOS ROM of the system stores the Setup utility. When you turn on the computer, the BIOS is immediately activated. Pressing the key immediately allows you to enter the Setup utility. If you are a little bit late pressing the key, POST (Power On Self Test) will continue with its test routines, thus preventing you from invoking the Setup. If you still wish to enter Setup, restart the system by pressing the "Reset" button or simultaneously pressing the <Ctrl>, <Alt> and <Delete> keys. You can also restart by turning the system Off and back On again. The following message will appear on the screen:

Press to Enter Setup

In general, you press the arrow keys to highlight items, <Enter> to select, the <PgUp> and <PgDn> keys to change entries, <F1> for help and <Esc> to quit.

When you enter the Setup utility, the Main Menu screen will appear on the screen. The Main Menu allows you to select from various setup functions and exit choices.

Warning: *It is strongly recommended that you avoid making any changes to the chipset defaults. These defaults have been carefully chosen by both AMI and your system manufacturer to provide the absolute maximum performance and reliability. Changing the defaults could cause the system to become unstable and crash in some cases.*

Main Settings

Aptio Setup Utility – Copyright © 2012 American Megatrends, Inc.

Main	Advanced	Chipset	Boot	Security	Save & Exit
Total Memory			16384 (DDR3)		
Memory Frequency			1333 Mhz		
System Date			[Wed 10/30/2013]		 → ← Select Screen
System Time			[21:52:06]		↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit

System Date

Set the Date. Use Tab to switch between Date elements.

System Time

Set the Time. Use Tab to switch between Time elements.

Advanced Settings

This section allows you to configure and improve your system and allows you to set up some system features according to your preference.

Aptio Setup Utility – Copyright © 2012 American Megatrends, Inc.

Main	Advanced	Chipset	Boot	Security	Save & Exit
<ul style="list-style-type: none">▶ PCI Subsystem Settings▶ ACPI Settings▶ Trusted Computing▶ Wakeup event Configuration▶ CPU Configuration▶ SATA Configuration▶ Shutdown Temperature Configuration▶ iSmart Controller▶ AMT Configuration▶ USB Configuration▶ NCT5523D Super IO Configuration▶ NCT5523D H/W Monitor					<p>→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit</p>

PCI Subsystem Settings

Aptio Setup Utility – Copyright © 2012 American Megatrends, Inc.

Main	Advanced	Chipset	Boot	Security	Save & Exit
PCI Bus Driver Version		V 2.05.02			
PCI Common Settings				→ ← Select Screen	
PCI Latency Timer		32 PCI Bus Clocks		↑ ↓ Select Item	
VGA Palette Snoop		Disabled		Enter: Select	
PERR# Generation		Disabled		+- Change Opt.	
SERR# Generation		Disabled		F1: General Help	
				F2: Previous Values	
				F3: Optimized Defaults	
				F4: Save & Exit	
				ESC: Exit	

PCI Latency Timer

Value to be programmed into PCI Latency Timer Register.

VGA Palette Snoop

Enables or disables VGA Palette Registers Snooping.

PERR# Generation

Enables or disables PCI device to generate PERR#.

SERR# Generation

Enables or disables PCI device to generate SERR#.

ACPI Settings

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Main	Advanced	Chipset	Boot	Security	Save & Exit
ACPI Settings					→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit
	Enable ACPI Auto Configuration		Disabled		
	Enable Hibernation		Enabled		
	ACPI Sleep State		S3 only (Suspend to ...)		
	Lock Legacy Resources		Disabled		
	S3 Video Repost		Disabled		

Enabled ACPI Auto Configuration

Enables or Disables BIOS ACPI Auto Configuration.

Enable Hibernation

Enables or Disables System ability to Hibernate (OS/S4 Sleep State). This option may be not effective with some OS.

ACPI Sleep State

Select ACPI sleep state the system will enter when the SUSPEND button is pressed.

Lock Legacy Resources

Enables or Disables Lock of Legacy Resources.

S3 Video Repost

Enable or Disable S3 Video Repost.

Trusted Computing

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Main	Advanced	Chipset	Boot	Security	Save & Exit
Configuration Security Device Support			Disabled		<pre>→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit</pre>

Security Device Support

This configuration is supported only with MI987AF. Enables or disables BIOS support for security device. O.S. will not show Security Device. TCG EFI protocol and INT1A interface will not be available.

TPM State

Enable/Disable Security Device. NOTE: Your Computer will reboot during restart in order to change State of the Device.

Pending operation

Schedule an Operation for the Security Device. NOTE: Your Computer will reboot during restart in order to change State of Security Device.

Wake up event settings

Aptio Setup Utility - Copyright © 2012 American Megatrends, Inc.

Main	Advanced	Chipset	Boot	Security	Save & Exit
Wake on Ring Wake on PCIE Wake Event			Disabled Disabled		<pre>→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit</pre>

Wake up by Ring / Wake up by PCIE WAKE#

The options are Disabled and Enabled.

CPU Configuration

This section shows the CPU configuration parameters.

Aptio Setup Utility – Copyright © 2012 American Megatrends, Inc.

Main	Advanced	Chipset	Boot	Security	Save & Exit
CPU Configuration					
Intel(R) Core(TM) i5-4570S CPU @ 2.90GHz					
CPU Signature	306c3				
Processor Family	6				
Microcode Patch	16				
FSB Speed	100 MHz				
Max CPU Speed	2900 MHz				
Min CPU Speed	800 MHz				
CPU Speed	2900 MHz				
Processor Cores	4				
Intel HT Technology	Not Supported				
Intel VT-x Technology	Supported				
Intel SMX Technology	Supported				
64-bit	Supported				
EIST Technology	Supported				
Active Processor Cores	All				→ ← Select Screen
Limit CPUID Maximum	Disabled				↑ ↓ Select Item
Execute Disable Bit	Enabled				Enter: Select
Intel Virtualization Technology	Enabled				+- Change Opt.
Boot performance mode	Turbo Performance				F1: General Help
EIST	Enabled				F2: Previous Values
Intel TXT(LT) Support	Disabled				F3: Optimized Defaults
					F4: Save & Exit
					ESC: Exit

Active Processor Cores

Number of cores to enable in each processor package.

Limit CPUID Maximum

Disabled for Windows XP.

Execute Disable Bit

XD can prevent certain classes of malicious buffer overflow attacks when combined with a supporting OS (Windows Server 2003 SP1, Windows XP SP2, SuSE Linux 9.2, RedHat Enterprise 3 Update 3.)

Intel Virtualization Technology

When enabled, a VMM can utilize the additional hardware capabilities provided by Vanderpool Technology.

Boot performance mode

Select the performance state that the BIOS will set before OS handoff.

EIST

Enable/Disable Intel Speedstep

Intel TXT(LT) Support

Enables or Disables Intel (R)TXT (LT) Support.

SATA Configuration

SATA Devices Configuration.

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Main	Advanced	Chipset	Boot	Security	Save & Exit
SATA Controller(s)		Enabled			
SATA Mode Selection		AHCI			
SATA Controller Speed		Default			
SATA Port0		Empty		→ ← Select Screen	
Software Preserve		Unknown		↑ ↓ Select Item	
Hot Plug		Disabled		Enter: Select	
SATA Port1		Empty		+- Change Opt.	
Software Preserve		Unknown		F1: General Help	
Hot Plug		Disabled		F2: Previous Values	
SATA Port4		Empty		F3: Optimized Defaults	
Software Preserve		Unknown		F4: Save & Exit	
Hot Plug		Disabled		ESC: Exit	

SATA Controller(s)

Enable or disable SATA Device.

SATA Mode Selection

Determines how SATA controller(s) operate.

- (1) IDE Mode.
- (2) AHCI Mode.
- (3) RAID Mode. (MI987AF only)

SATA Controller Speed

Indicates the maximum speed the SATA controller can support.

Hot Plug

Designates this port as Hot Pluggable.

Shutdown Temperature Configuration

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Main	Advanced	Chipset	Boot	Security	Save & Exit
	ACPI Shutdown Temperature		Disabled		→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save ESC: Exit

ACPI Shutdown Temperature

The default setting is Disabled.

iSmart Controller

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Main	Advanced	Chipset	Boot	Security	Save & Exit
	iSmart Controller				→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit
	Eup/Erp standby power control		Keep standby power		
	Power-On after Power failure		Disable		
	Schedule Slot 1		None		
	Schedule Slot 2		None		

Eup/Erp standby power control

This configuration is supported only with MI987EF. Eup/Erp control on S5[Keep standby power] Enable all of the standby power and ignore Eup/Erp specification [Ethernet Only] Only provide the standby power for Ethernet chip.[Disabled] Shutdown all of the standby power.

Power-On after Power failure

This field sets the system power status whether *Disable* or *Enable* when power returns to the system from a power failure situation.

Schedule Slot 1 / 2

Setup the hour/minute for system power on.

AMT Configuration

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Main	Advanced	Chipset	Boot	Security	Save & Exit
Intel AMT	Enabled				
BIOS Hotkey Pressed	Disabled				
MEBx Selection Screen	Disabled				
Hide Un-Configure ME Confirmation	Disabled				
Un-Configure ME	Disabled				
Amt Wait Timer	0				
Activate Remote Assistance Process	Disabled				
USB Configure	Enabled				
PET Progress	Enabled				
AMT CIRA Timeout	0				
Watchdog	Disabled				
OS Timer	0				
BIOS Timer	0				

→ ← Select Screen
↑ ↓ Select Item
Enter: Select
+- Change Opt.
F1: General Help
F2: Previous Values
F3: Optimized Defaults
F4: Save & Exit
ESC: Exit

AMT configuration is supported only with MI987AF (with iAMT function).

Intel AMT

Enable/Disable Intel (R) Active Management Technology BIOS Extension.

Note: iAMT H/W is always enabled. This option just controls the BIOS extension execution. If enabled, this requires additional firmware in the SPI device.

BIOS Hotkey Pressed

OEMFLag Bit 1: Enable/Disable BIOS hotkey press.

AMT Configuration

OEMFLag Bit 2: Enable/Disable MEBx selection screen.

Hide Un-Configure ME Configuration

OEMFLag Bit 6: Hide Un-Configure ME without password Confirmation Prompt.

Un-Configure ME

OEMFLag Bit 15: Un-Configure ME without password.

Amt Wait Timer

Set timer to wait before sending ASF_GET_BOOT_OPTIONS.

Activate Remote Assistance Process

Trigger CIRA boot.

USB Configure

Enable/Disable USB Configure function.

PET Progress

User can Enable/Disable PET Events progress to receive PET events or not.

Watchdog Timer

Enable/Disable Watchdog Timer.

USB Configuration

Aptio Setup Utility – Copyright © 2012 American Megatrends, Inc.

Main	Advanced	Chipset	Boot	Security	Save & Exit
USB Configuration					
USB Module Version			8.10.28		
USB Devices:					
	2 Keyboards, 1 Mouse, 2 Hubs				
Legacy USB Support		Enabled		→ ← Select Screen	
USB3.0 Support		Enabled		↑ ↓ Select Item	
XHCI Hand-off		Enabled		Enter: Select	
EHCI Hand-off		Enabled		+ - Change Opt.	
USB Mass Storage Driver Support		Enabled		F1: General Help	
USB hardware delays and time-outs:				F2: Previous Values	
USB Transfer time-out		20 sec		F3: Optimized Defaults	
Device reset time-out		20 sec		F4: Save & Exit	
Device power-up delay		Auto		ESC: Exit	

Legacy USB Support

Enables Legacy USB support.

AUTO option disables legacy support if no USB devices are connected.

DISABLE option will keep USB devices available only for EFI applications.

USB3.0 Support

Enable/Disable USB3.0 (XHCI) Controller support.

XHCI Hand-off

This is a workaround for OSes without XHCI hand-off support. The XHCI ownership change should be claimed by XHCI driver.

EHCI Hand-off

This is a workaround for OSes without EHCI hand-off support. The XHCI ownership change should be claimed by EHCI driver.

USB Mass Storage Driver Support

Enable/Disable USB Mass Storage Driver Support.

USB Transfer time-out

The time-out value for Control, Bulk, and Interrupt transfers.

Device reset time-out

USB mass Storage device start Unit command time-out.

Device power-up delay

Maximum time the device will take before it properly reports itself to the Host Controller. 'Auto' uses default value: for a Root port it is 100ms, for a Hub port the delay is taken from Hub descriptor.

NCT5523D Super IO Configuration

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Main	Advanced	Chipset	Boot	Security	Save & Exit
	NCT5523D Super IO Configuration		NCT5523D		<p>→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit</p>

Serial Port Configuration

Set Parameters of Serial Ports. User can Enable/Disable the serial port and Select an optimal settings for the Super IO Device.

NCT5523D H/W Monitor

Aptio Setup Utility - Copyright © 2012 American Megatrends, Inc.

Main	Advanced	Chipset	Boot	Security	Save & Exit
PC Health Status					
	Smart SYS_FAN1 Function		Disabled		→ ← Select Screen
	Smart CPU_FAN1 Function		Disabled		↑ ↓ Select Item
	SYS temp		+33.0 C		Enter: Select
	CPU temp		+34.5 C		+- Change Opt.
	SYS_FAN1 Speed		4066 RPM		F1: General Help
	CPU_FAN1 Speed		4066 RPM		F2: Previous Values
	Vcore		+1.704 V		F3: Optimized Defaults
	+1.5V		+1.544 V		F4: Save & Exit
	AVCC		+3.360 V		ESC: Exit
	VSB3		+3.344 V		

Smart SYS_FAN1/CPU_FAN1 Function

This field enables or disables the smart fan feature.

Disabled (default)

50 °C

60 °C

70 °C

80 °C

90 °C

Temperatures/Voltages

These fields are the parameters of the hardware monitoring function feature of the motherboard. The values are read-only values as monitored by the system and show the PC health status.

Chipset Settings

This section allows you to configure and improve your system and allows you to set up some system features according to your preference.

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Main	Advanced	Chipset	Boot	Security	Save & Exit
▶ PCH-IO Configuration ▶ System Agent (SA) Configuration					→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit

PCH-IO Configuration

This section allows you to configure the North Bridge Chipset.

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Main	Advanced	Chipset	Boot	Security	Save & Exit
Intel PCH RC Version		1.6.2.0			→ ← Select Screen
Intel PCH SKU Name		Q87			↑ ↓ Select Item
Intel PCH Rev ID		05/C2			Enter: Select
▶ PCI Express Configuration					+- Change Opt.
▶ PCH Azalia Configuration					F1: General Help
PCH LAN Controller		Enabled			F2: Previous Values
Wake on LAN		Enabled			F3: Optimized Defaults
SLP_S4 Assertion Width		4-5 Seconds			F4: Save & Exit
					ESC: Exit

PCH LAN Controller

Enable or disable onboard NIC.

Wake on LAN

Enable or disable integrated LAN to wake the system. (The Wake On LAN cannot be disabled if ME is on at Sx state.)

SLP_S4 Assertion Width

Select a minimum assertion width of the SLP_S4# signal.

PCI Express Configuration

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Main	Advanced	Chipset	Boot	Security	Save & Exit
PCI Express Configuration					
		PCI Express Clock Gating	Enabled		
		DMI Link ASPM Control	Enabled		
		DMI Link Extended Synch Control	Disabled		
		PCIe-USB Glitch W/A	Disabled		
		Subtractive Decode	Disabled		
 ► PCI Express Root Port 1					
► PCI Express Root Port 2					
► PCI Express Root Port 3					
► PCI Express Root Port 4					
► PCI Express Root Port 5					
PCI-E Port 6 is assigned to LAN					
► PCI Express Root Port 7					
► PCI Express Root Port 8					
 → ← Select Screen					
↑ ↓ Select Item					
Enter: Select					
+- Change Opt.					
F1: General Help					
F2: Previous Values					
F3: Optimized Defaults					
F4: Save & Exit					
ESC: Exit					

PCI Express Clock Gating

Enable or disable PCI Express Clock Gating for each root port.

DMI Link ASPM Control

The control of Active State Power Management on both NB side and SB side of the DMI Link.

DMI Link Extended Synch Control

The control of Extended Synch on SB side of the DMI Link.

PCIe-USB Glitch W/A

PCIe-USB Glitch W/A for bad USB device(s) connected behind PCIE/PEG port.

Subtractive Decode

Enable or disable PCI Express Subtractive Decode.

PCH Azalia Configuration

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Main	Advanced	Chipset	Boot	Security	Save & Exit
PCH Azalia Configuration					
Azalia		Auto			→ ← Select Screen
Azalia Docking Support		Enabled			↑ ↓ Select Item
Azalia PME		Enabled			Enter: Select
					+- Change Opt.
					F1: General Help
					F2: Previous Values
					F3: Optimized Defaults
					F4: Save & Exit
					ESC: Exit

Azalia

Control Detection of the Azalia device.

Disabled = Azalia will be unconditionally disabled.

Enabled Azalia will be unconditionally Enabled.

Auto = Azalia will be enabled if present, disabled otherwise.

Azalia Docking Support

Enable or disable Azalia Docking Support of Audio Controller.

Azalia PME

Enable or disable Power Management capability of Audio Controller.

System Agent (SA) Configuration

Aptio Setup Utility – Copyright © 2012 American Megatrends, Inc.

Main	Advanced	Chipset	Boot	Security	Save & Exit
System Agent Bridge Name		Haswell			
System Agent RC Version		1.6.2.0			
VT-d Capability		Supported			
VT-d		Enabled			
► Graphics Configuration					→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit

VT-d

Check to enable VT-d function on MCH.

Graphics Configuration

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Main	Advanced	Chipset	Boot	Security	Save & Exit
Graphics Configuration					
IGFX VBIOS Version		2170			
IGfx Frequency		700 MHz			
Primary Display		Auto			
Primary PEG		Auto			
Primary PCIE		Auto			
Internal Graphics		Auto			
Aperture Size		256MB			
DVMT Pre-Allocated		32M			
DVMT Total Gfx Mem		256MB			
Gfx Low Power Mode		Enabled			→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit

Primary Display

Select which of IGFX/PEG/PCI graphics device should be Primary Display or select SG for switchable Gfx.

Primary PEG

Select PEG0/PEG1/PEG2/PEG3 Graphics device should be Primary PEG.

Primary PCIE

Select PCIE0/PCIE1/PCIE2/PCIE3/PCIE4/PCIE5/PCIE6/PCIE7
Graphics device should be Primary PCIE.

Internal Graphics

Keep IGD enabled based on the setup options.

Aperture Size

Select the Aperture Size.

DVMT Pre-Allocated

Select DVMT 5.0 Pre-Allocated (Fixed) Graphics Memory Size used by the Internal Graphics Device.

DVMT Total Gfx Mem

Select DVMT 5.0 Total Graphics Memory Size used by the Internal Graphics Device.

Gfx Low Power Mode

This option is applicable for SFF only.

Boot Settings

This section allows you to configure the boot settings.

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Main	Advanced	Chipset	Boot	Security	Save & Exit
Boot Configuration					
Setup Prompt Timeout			1		
Bootup NumLock State			On		
Quiet Boot			Disabled	→ ← Select Screen	
Fast Boot			Disabled	↑ ↓ Select Item	
Boot Option Priorities				Enter: Select	
► CSM16 parameters				+- Change Opt.	
CSM parameters				F1: General Help	
				F2: Previous Values	
				F3: Optimized Defaults	
				F4: Save & Exit	
				ESC: Exit	

Setup Prompt Timeout

Number of seconds to wait for setup activation key.
65535(0xFFFF) means indefinite waiting.

Bootup NumLock State

Select the keyboard NumLock state.

Quiet Boot

Enables or disables Quiet Boot option.

Fast Boot

Enables or disables boot with initialization of a minimal set of devices required to launch active boot option. Has no effect for BBS boot options.

Boot Option Priorities

Sets the system boot order.

CSM parameters

This section allows you to configure the boot settings.

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Main	Advanced	Chipset	Boot	Security	Save & Exit
Launch CSM			Enabled		
Boot option filter			UEFI and Legacy		→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit
Launch PXE OpROM policy			Do not launch		
Launch Storage OpROM policy			Legacy only		
Launch Video OpROM policy			Legacy only		
Other PCI device ROM priority			Legacy OpROM		

Launch CSM

This option controls if CSM will be launched.

Boot option filter

This option controls what devices system can boot to.

Launch PXE OpROM policy

Controls the execution of UEFI and Legacy PXE OpROM.

Launch Storage OpROM policy

Controls the execution of UEFI and Legacy Storage OpROM.

Launch Video OpROM policy

Controls the execution of UEFI and Legacy Video OpROM.

Other PCI device ROM priority

For PCI devices other than Network, Mass storage or Video defines which OpROM to launch.

Security Settings

This section allows you to configure and improve your system and allows you to set up some system features according to your preference.

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Main	Advanced	Chipset	Boot	Security	Save & Exit
Password Description					<pre>→ ← Select Screen ↑ ↓ Select Item Enter: Select +- Change Opt. F1: General Help F2: Previous Values F3: Optimized Defaults F4: Save & Exit ESC: Exit</pre>

Administrator Password

Set Administrator Password.

Save & Exit Settings

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Main	Advanced	Chipset	Boot	Security	Save & Exit
Save Changes and Exit					
Discard Changes and Exit					
Save Changes and Reset					
Discard Changes and Reset					
Save Options					→ ← Select Screen
Save Changes					↑ ↓ Select Item
Discard Changes					Enter: Select
Restore Defaults					+- Change Opt.
Save as User Defaults					F1: General Help
Restore User Defaults					F2: Previous Values
					F3: Optimized Defaults
					F4: Save & Exit
					ESC: Exit

Save Changes and Exit

Exit system setup after saving the changes.

Discard Changes and Exit

Exit system setup without saving any changes.

Save Changes and Reset

Reset the system after saving the changes.

Discard Changes and Reset

Reset system setup without saving any changes.

Save Changes

Save Changes done so far to any of the setup options.

Discard Changes

Discard Changes done so far to any of the setup options.

Restore Defaults

Restore/Load Defaults values for all the setup options.

Save as User Defaults

Save the changes done so far as User Defaults.

Restore User Defaults

Restore the User Defaults to all the setup options.

Drivers Installation

This section describes the installation procedures for software and drivers. The software and drivers are included with the motherboard. If you find the items missing, please contact the vendor where you made the purchase. The contents of this section include the following:

Intel Chipset Software Installation Utility	46
VGA Drivers Installation.....	47
Realtek HD Audio Driver Installation	48
LAN Drivers Installation	49
Intel® Management Engine Interface	50
Intel® USB 3.0 Drivers	51

IMPORTANT NOTE:

After installing your Windows operating system, you must install first the Intel Chipset Software Installation Utility before proceeding with the drivers installation.

Intel Chipset Software Installation Utility

The Intel Chipset Drivers should be installed first before the software drivers to enable Plug & Play INF support for Intel chipset components. Follow the instructions below to complete the installation.

1. Insert the DVD that comes with the board. Click **Intel** and then **Intel(R) 8 Series Chipset Drivers**.



2. Click **Intel(R) Chipset Software Installation Utility**.



3. When the Welcome screen to the Intel® Chipset Device Software appears, click **Next** to continue.
4. Click **Yes** to accept the software license agreement and proceed with the installation process.
5. On the Readme File Information screen, click **Next** to continue the installation.
6. The Setup process is now complete. Click **Finish** to restart the computer and for changes to take effect.

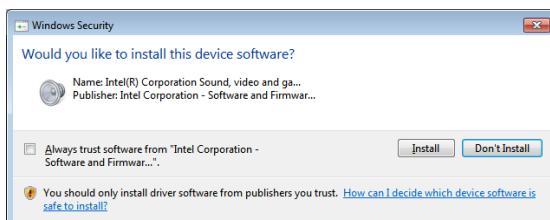
VGA Drivers Installation

1. Insert the DVD that comes with the board. Click **Intel** and then **Intel(R) 8 Series Chipset Drivers**. Click **Intel(R) Graphics Driver**.



2. When the Welcome screen appears, click **Next** to continue.
3. Click **Yes** to agree with the license agreement and continue the installation.
4. On the Readme File Information screen, click **Next** to continue the installation of the Intel® HD Graphics Driver.

5. On the screen shown below, click **Install** to continue.



6. On the Setup Progress screen, click **Next** to continue.
7. Setup complete. Click **Finish** to restart the computer and for changes to take effect.

Realtek HD Audio Driver Installation

1. Insert the DVD that comes with the board. Click **Intel** and then **Intel(R) 8 Series Chipset Drivers**. Click **Realtek High Definition Audio Driver**.



2. On the Welcome to the InstallShield Wizard screen, click **Next** to proceed with and complete the installation process.
3. The InstallShield Wizard Complete. Click **Finish** to restart the computer and for changes to take effect.

LAN Drivers Installation

1. Insert the DVD that comes with the board. Click **Intel** and then **Intel(R) 8 Series Chipset Drivers**. Click **Intel(R) PRO LAN Network Drivers**.



2. Click **Install Drivers and Software**.
4. When the Welcome screen appears, click **Next**.
5. Click **Next** to to agree with the license agreement.
6. Click the checkbox for **Drivers** in the Setup Options screen to select it and click **Next** to continue.
7. The wizard is ready to begin installation. Click **Install** to begin the installation.
8. When InstallShield Wizard is complete, click **Finish**.

Intel® Management Engine Interface



The following application requires Microsoft .NET Framework 3.5 or later: Intel® Management Engine Components. Please install the latest version of Microsoft .NET Framework from Microsoft Download Center to run this application correctly.

Follow the steps below to install the Intel Management Engine.

1. Insert the DVD that comes with the board. Click **Intel** and then **Intel(R) 8 Series Chipset Drivers** and then **Intel(R) ME 9.0 Drivers**.



2. When the Welcome screen to the InstallShield Wizard for Intel® Management Engine Components, click the checkbox for **Install Intel® Control Center** & click **Next**.
3. Click **Yes** to to agree with the license agreement.
4. When the Setup Progress screen appears, click **Next**. Then, click **Finish** when the setup progress has been successfully installed.

Intel® USB 3.0 Drivers

1. Insert the DVD that comes with the board. Click **Intel** and then **Intel(R) 8 Series Chipset Drivers**. Click **Intel(R) USB 3.0 Drivers**.



2. When the Welcome screen to the InstallShield Wizard for Intel® USB 3.0 eXtensible Host Controller Driver, click **Next**.
3. Click **Yes** to agree with the license agreement and continue the installation.
4. On the Readme File Information screen, click **Next** to continue the installation of the Intel® USB 3.0 eXtensible Host Controller Driver.
5. When the Setup Progress screen appears, click **Next**. Setup complete. Click **Finish** to restart the computer and for changes to take effect.

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Appendix

A. I/O Port Address Map

Each peripheral device in the system is assigned a set of I/O port addresses which also becomes the identity of the device. The following table lists the I/O port addresses used.

Address	Device Description
0000h-001Fh	Direct memory access controller
0000h-001Fh	PCI bus
0040h-0043h	System timer
0050h-0053h	System timer
0070h-0077h	System CMOS/real time clock
0081h-0091h	Direct memory access controller
0093h-009Fh	Direct memory access controller
00C0h-00DFh	Direct memory access controller
00F0h-00F0h	Numeric data processor
02F8h-02FFh	Communications Port (COM2)
03B0h-03BBh	Intel(R) HD Graphics 4600
03C0h-03DFh	Intel(R) HD Graphics 4600
03F8h-03FFh	Communications Port (COM1)
0D00h-FFFFh	PCI bus
E000h-EFFFh	Intel(R) 8 Series/C220 Series PCI Express Root Port #7 - 8C1C
F000h-F03Fh	Intel(R) HD Graphics 4600
F040h-F05Fh	Intel(R) 8 Series/C220 Series SMBus Controller - 8C22
F060h-F07Fh	Intel(R) 8 Series/C220 Series SATA AHCI Controller - 8C02
F0A0h-F0A3h	Intel(R) 8 Series/C220 Series SATA AHCI Controller - 8C02
F0B0h-F0B7h	Intel(R) 8 Series/C220 Series SATA AHCI Controller - 8C02
F0C0h-F0C3h	Intel(R) 8 Series/C220 Series SATA AHCI Controller - 8C02
F0D0h-F0D7h	Intel(R) 8 Series/C220 Series SATA AHCI Controller - 8C02
F0E0h-F0E7h	Intel(R) Active Management Technology - SOL (COM3)

B. Interrupt Request Lines (IRQ)

Peripheral devices use interrupt request lines to notify CPU for the service required. The following table shows the IRQ used by the devices on board.

Level	Function
IRQ0	System Timer
IRQ3	Serial Port #2
IRQ4	Serial Port #1
IRQ 10	Intel(R) 8 Series/C220 Series SMBus Controller - 8C22
IRQ 13	Numeric data processor
IRQ 16	High Definition Audio Controller
IRQ 16	Intel(R) 8 Series/C220 Series USB EHCI #2 - 8C2D
IRQ 16	Intel(R) Management Engine Interface
IRQ 19	Intel(R) 8 Series/C220 Series SATA AHCI Controller - 8C02
IRQ 19	Intel(R) Active Management Technology - SOL (COM3)
IRQ 22	High Definition Audio Controller
IRQ 23	Intel(R) 8 Series/C220 Series USB EHCI #1 - 8C26

C. Digital I/O Sample Code

File of the NCT5523D.H

```
//-----
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY
// KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE
// IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR
// PURPOSE.
//-----
#ifndef __NCT5523D_H
#define __NCT5523D_H      1
//-----
#define NCT5523D_INDEX_PORT      (NCT5523D_BASE)
#define NCT5523D_DATA_PORT       (NCT5523D_BASE+1)
//-----
#define NCT5523D_REG_LD          0x07
//-----
#define NCT5523D_UNLOCK          0x87
#define NCT5523D_LOCK            0xAA
//-----
unsigned int Init_NCT5523D(void);
void Set_NCT5523D_LD(unsigned char);
void Set_NCT5523D_Reg(unsigned char, unsigned char);
unsigned char Get_NCT5523D_Reg(unsigned char);
//-----
#endif//__NCT5523D_H
```

APPENDIX

File of the MAIN.CPP

```
//-----
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY
// KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE
// IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR
// PURPOSE.
//-----
#include <dos.h>
#include <conio.h>
#include <stdio.h>
#include <stdlib.h>
#include "NCT5523D.H"
//-----
int main (void);

void Dio5Initial(void);
void Dio5SetOutput(unsigned char);
unsigned char Dio5GetInput(void);
void Dio5SetDirection(unsigned char);
unsigned char Dio5GetDirection(void);
//-----
int main (void)
{
    char SIO;

    SIO = Init_NCT5523D();
    if (SIO == 0)
    {
        printf("Can not detect Nuvoton NCT5523D, program abort.\n");
        return(1);
    }

    Dio5Initial();

    //for GPIO20..27
    Dio5SetDirection(0x0F); //GP20..23 = input, GP24..27=output
    printf("Current DIO direction = 0x%X\n", Dio5GetDirection());

    printf("Current DIO status = 0x%X\n", Dio5GetInput());

    printf("Set DIO output to high\n");
    Dio5SetOutput(0x0F);

    printf("Set DIO output to low\n");
    Dio5SetOutput(0x00);

    return 0;
}
//-----
```

```
void Dio5Initial(void)
{
    unsigned char ucBuf;

    ucBuf = Get_NCT5523D_Reg(0x1C);
    ucBuf &= ~0x02;
    Set_NCT5523D_Reg(0x1C, ucBuf);

    Set_NCT5523D_LD(0x07);                                //switch to logic device 7
    //enable the GP2 group
    ucBuf = Get_NCT5523D_Reg(0x30);
    ucBuf |= 0x04;
    Set_NCT5523D_Reg(0x30, ucBuf);
}

//-----
void Dio5SetOutput(unsigned char NewData)
{
    Set_NCT5523D_LD(0x07);                                //switch to logic device 7
    Set_NCT5523D_Reg(0xE1, NewData);
}

//-----
unsigned char Dio5GetInput(void)
{
    unsigned char result;

    Set_NCT5523D_LD(0x07);                                //switch to logic device 7
    result = Get_NCT5523D_Reg(0xE1);
    return (result);
}

//-----
void Dio5SetDirection(unsigned char NewData)
{
    //NewData : 1 for input, 0 for output
    Set_NCT5523D_LD(0x07);                                //switch to logic device 7
    Set_NCT5523D_Reg(0xE8, NewData);
}

//-----
unsigned char Dio5GetDirection(void)
{
    unsigned char result;

    Set_NCT5523D_LD(0x07);                                //switch to logic device 7
    result = Get_NCT5523D_Reg(0xE8);
    return (result);
}
```

APPENDIX

File of the NCT5523D.CPP

```
//-----
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY
// KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE
// IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR
// PURPOSE.
//-----
#include "NCT5523D.H"
#include <dos.h>
//-----
unsigned int NCT5523D_BASE;
void Unlock_NCT5523D (void);
void Lock_NCT5523D (void);
//-----
unsigned int Init_NCT5523D(void)
{
    unsigned int result;
    unsigned char ucDid;

    NCT5523D_BASE = 0x4E;
    result = NCT5523D_BASE;

    ucDid = Get_NCT5523D_Reg(0x20);
    if (ucDid == 0xC4)                                //NCT5523D??
    {
        goto Init_Finish;    }

    NCT5523D_BASE = 0x2E;
    result = NCT5523D_BASE;

    ucDid = Get_NCT5523D_Reg(0x20);
    if (ucDid == 0xC4)                                //NCT5523D??
    {
        goto Init_Finish;    }

    NCT5523D_BASE = 0x00;
    result = NCT5523D_BASE;

Init_Finish:
    return (result);
}
//-----
void Unlock_NCT5523D (void)
{
    outportb(NCT5523D_INDEX_PORT, NCT5523D_UNLOCK);
    outportb(NCT5523D_INDEX_PORT, NCT5523D_UNLOCK);
}
//-----
void Lock_NCT5523D (void)
{
    outportb(NCT5523D_INDEX_PORT, NCT5523D_LOCK);
}
//-----
```

```
void Set_NCT5523D_LD( unsigned char LD)
{
    Unlock_NCT5523D();
    outportb(NCT5523D_INDEX_PORT, NCT5523D_REG_LD);
    outportb(NCT5523D_DATA_PORT, LD);
    Lock_NCT5523D();
}

//-----
void Set_NCT5523D_Reg( unsigned char REG, unsigned char DATA)
{
    Unlock_NCT5523D();
    outportb(NCT5523D_INDEX_PORT, REG);
    outportb(NCT5523D_DATA_PORT, DATA);
    Lock_NCT5523D();
}

//-----
unsigned char Get_NCT5523D_Reg(unsigned char REG)
{
    unsigned char Result;
    Unlock_NCT5523D();
    outportb(NCT5523D_INDEX_PORT, REG);
    Result = inportb(NCT5523D_DATA_PORT);
    Lock_NCT5523D();
    return Result;
}

//-----
```

D. Watchdog Timer Configuration

The WDT is used to generate a variety of output signals after a user programmable count. The WDT is suitable for use in the prevention of system lock-up, such as when software becomes trapped in a deadlock. Under these sorts of circumstances, the timer will count to zero and the selected outputs will be driven. Under normal circumstance, the user will restart the WDT at regular intervals before the timer counts to zero.

SAMPLE CODE:

```
File of the NCT5523D.H
//-----
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY
// KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE
// IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR
// PURPOSE.
//
//-----
#ifndef __NCT5523D_H
#define __NCT5523D_H           1
//-----
#define NCT5523D_INDEX_PORT      (NCT5523D_BASE)
#define NCT5523D_DATA_PORT       (NCT5523D_BASE+1)
//-----
#define NCT5523D_REG_LD          0x07
//-----
#define NCT5523D_UNLOCK          0x87
#define NCT5523D_LOCK            0xAA
//-----
unsigned int Init_NCT5523D(void);
void Set_NCT5523D_LD(unsigned char);
void Set_NCT5523D_Reg(unsigned char, unsigned char);
unsigned char Get_NCT5523D_Reg(unsigned char);
//-----
#endif//__NCT5523D_H
```

File of the MAIN.CPP.

```
//-----
//-----  
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY  
// KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE  
// IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR  
// PURPOSE.  
//-----  
#include <dos.h>  
#include <conio.h>  
#include <stdio.h>  
#include <stdlib.h>  
#include "NCT5523D.H"  
//-----  
int main (void);  
  
void WDTInitial(void);  
void WDTEnable(unsigned char);  
void WDTDisable(void);  
  
//-----  
int main (void)  
{  
    char SIO;  
  
    SIO = Init_NCT5523D();  
    if (SIO == 0)  
    {  
        printf("Can not detect Nuvoton NCT5523D, program abort.\n");  
        return(1);  
    }  
  
    WDTInitial();  
  
    WDTEnable(10);  
  
    WDTDisable();  
  
    return 0;  
}  
//-----  
void WDTInitial(void)  
{  
    unsigned char bBuf;  
    Set_NCT5523D_LD(0x08);  
    bBuf = Get_NCT5523D_Reg(0x30);  
    bBuf &= (~0x01);  
    Set_NCT5523D_Reg(0x30, bBuf);  
    //Enable WDTO  
}  
//-----
```

APPENDIX

```
void WDTEnable(unsigned char NewInterval)
{
    unsigned char bBuf;

    Set_NCT5523D_LD(0x08);                                //switch to logic device 8
    Set_NCT5523D_Reg(0x30, 0x01);                          //enable timer

    bBuf = Get_NCT5523D_Reg(0xF0);
    bBuf &= (~0x08);
    Set_NCT5523D_Reg(0xF0, bBuf);                          //count mode is second

    Set_NCT5523D_Reg(0xF1, NewInterval);                  //set timer
}

//-----
void WDTDisable(void)
{
    Set_NCT5523D_LD(0x08);                                //switch to logic device 8
    Set_NCT5523D_Reg(0xF1, 0x00);                          //clear watchdog timer
    Set_NCT5523D_Reg(0x30, 0x00);                          //watchdog disabled
}

//-----
```

```
File of the NCT5523D.CPP
//-----
// THIS CODE AND INFORMATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY
// KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE
// IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR
// PURPOSE.
//
//-----
#include "NCT5523D.H"
#include <dos.h>
//-----
unsigned int NCT5523D_BASE;
void Unlock_NCT5523D (void);
void Lock_NCT5523D (void);
//-----
unsigned int Init_NCT5523D(void)
{
    unsigned int result;
    unsigned char ucDid;

    NCT5523D_BASE = 0x4E;
    result = NCT5523D_BASE;

    ucDid = Get_NCT5523D_Reg(0x20);
    if (ucDid == 0xC4)           //NCT5523D??
    {
        goto Init_Finish;    }

    NCT5523D_BASE = 0x2E;
    result = NCT5523D_BASE;

    ucDid = Get_NCT5523D_Reg(0x20);
    if (ucDid == 0xC4)           //NCT5523D??
    {
        goto Init_Finish;    }

    NCT5523D_BASE = 0x00;
    result = NCT5523D_BASE;

Init_Finish:
    return (result);
}
//-----
void Unlock_NCT5523D (void)
{
    outportb(NCT5523D_INDEX_PORT, NCT5523D_UNLOCK);
    outportb(NCT5523D_INDEX_PORT, NCT5523D_UNLOCK);
}
//-----
void Lock_NCT5523D (void)
{
    outportb(NCT5523D_INDEX_PORT, NCT5523D_LOCK);
}
//-----
```

APPENDIX

```
void Set_NCT5523D_LD( unsigned char LD)
{
    Unlock_NCT5523D();
    outportb(NCT5523D_INDEX_PORT, NCT5523D_REG_LD);
    outportb(NCT5523D_DATA_PORT, LD);
    Lock_NCT5523D();
}

//-----
void Set_NCT5523D_Reg( unsigned char REG, unsigned char DATA)
{
    Unlock_NCT5523D();
    outportb(NCT5523D_INDEX_PORT, REG);
    outportb(NCT5523D_DATA_PORT, DATA);
    Lock_NCT5523D();
}

//-----
unsigned char Get_NCT5523D_Reg(unsigned char REG)
{
    unsigned char Result;
    Unlock_NCT5523D();
    outportb(NCT5523D_INDEX_PORT, REG);
    Result = inportb(NCT5523D_DATA_PORT);
    Lock_NCT5523D();
    return Result;
}

//-----
```